LATE TERTIARY MARSUPIALS FROM SOUTH AUSTRALIA

By R. A. STIRTON (Museum of Paleontology, University of California)

Fig. 1-11

INTRODUCTION.

In 1953 Richard H. Tedford and R. A. Stirton received Fulbright awards to search for Tertiary marsupials and monotremes in South Australia. Tertiary mammalian remains have turned up from time to time on the mainland of Australia but the stratigraphy and in many instances the exact localities of these important discoveries have not been adequately recorded.

Some fossils now thought to be Pleistocene are surely Pliocene and others may be older. This is particularly true of some of the specimens said to have come from the Darling Downs area in Queensland. Also during the past few years Edmund D. Gill, of the National Museum, Melbourne, has been stressing an earlier age for some of the fossils from Victoria. Four of his marsupial specimens from marine formations should be helpful in establishing a correlation between continental and marine formations.

Our 1953 expedition was a co-operative project between the South Australian Museum, the Department of Geology of the University of Adelaide, and the Museum of Paleontology of the University of California. Those who actively participated in different phases of the field work were Norman B. Tindale, Paul F. Lawson, Geoffrey D. Woodard, Harold C. Reynolds, Tedford and Stirton. Though we worked in human cultural levels at Lake Menindee and in the *Diprotodon* locality at Lake Callabonna, our prime objective was to locate concentrations of Tertiary mammals to initiate work on the continental stratigraphy of Australia.

Toward the end of our last trip in the interior Woodard discovered a concentration of late Tertiary mammalian materials in a sandy channel deposit along the edge of Lake Palankarinna east of Lake Eyre. In the limited time available we collected from that site a series of macropodid jaws, teeth and limb bones, parts of two kinds of diprotodonts, a fragmentary bandicoot mandible as well as numerous crocodilian and chelonian fragments, teleost bones, lung fish teeth and crayfish gastroliths (Stirton and Woodard, 1954).

This report gives preliminary descriptions of the mammals and is not a comprehensive faunal report. We hope to secure a more varied faunal representation and better preserved materials after we open a quarry at the Woodard locality in July, 1954.

ACKNOWLEDGMENTS.

We are grateful to Sir Douglas Mawson, Professor A. R. Alderman, Mr. Herbert M. Hale, Mr. C. Warren Bonython and our many other Australian friends without whose help and encouragement this project would have been impossible. We also wish to express our appreciation for the Fulbright awards, to the Associates in Tropical Biogeography at the University of California and others who helped to make this work possible. Dr. A. T. Hopwood, of the British Museum of Natural History, kindly placed at the author's disposal Owen's types and generously took much of his time in discussing his ideas on some of these specimens. Mr. and Mrs. D. J. Oldfield, of Etadunna Station, were most hospitable and helped us in many ways. Mr. Jack Stewart, of the Electricity Trust Company at Leigh Creek, gave us invaluable assistance and suggestions with our transportation problems. The illustrations were prepared by Mr. Owen J. Poe, staff artist in our Museum. All measurements are in millimeters.

TYPE, LOCALITY AND AGE OF THE PALANKARINNA FAUNA.

The Woodard locality where the fossil bones were found is a grayish sandy channel deposit with some unconsolidated ferruginous concentrations ranging from one-fourth of an inch to two inches in diameter. Gypsum occurs throughout the beds but most if not all of it is secondary in origin. These channel sands were laid down in a formation composed primarily of greenish-blue and red gypsiferous clays with a basal conglomerate derived from the Durierust chert. The channel sands are 35 feet above the basal conglomerate. The maximum thickness of the formation where the channel sands occur is 72 feet, though the total thickness may be greater.

The exposures are along the west side of Lake Palankarinna, east of Lake Eyre; 18 miles S. 75° W. of Etadunna Station homestead. Military grid reference 656431, ordinance sheet Marree, South Australia, H54/1.2.5.6, zones 5 and 6, first edition 1942, scale 1 : 506880. U.C. locality V5367 (Fig. 1).

Age of the fauna is difficult if not impossible to determine accurately at this time. Perhaps the best key to an age is the fragmentary nototherc (Fig. 6) that seems closely related but more advanced than a specimen in the National Museum at Melbourne. The Victorian specimen came from the Sandringham sands ("Cheltenhamian stage" of Singleton, 1941) at Beaumaris. Singleton (1941), Gill (1950), and Glaessner (1951) refer this "stage" to the late Miocene, and Crespin (oral communication) calls it early Pliocene. The Palankarinna fauna therefore has been referred to the early or, possibly, middle Pliocene.

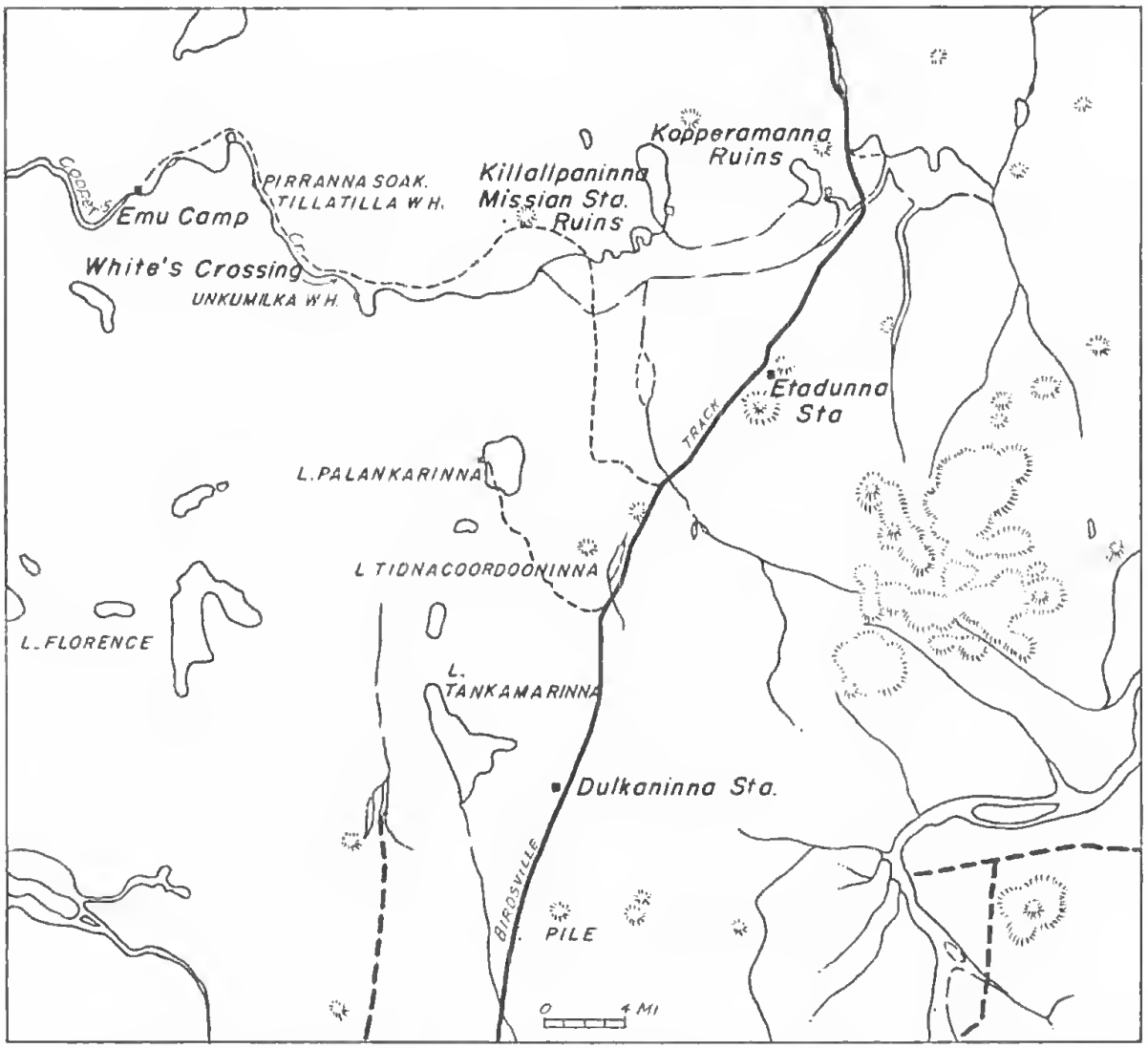

Fig. 1. Map showing Woodard Locality at Lake Palankarinna east of Lake Eyre, South Australia.

PALANKARINNA FAUNA—WOODARD LOCALITY.

FAMILY PERAMELIDAE.

The first Tertiary fossil of a bandicoot was found by Mr. Tedford on July 30, 1953, when we were opening the Palankarinna quarry. Unfortunately it was in the weathered zone near the surface and consequently was badly shattered.

Genus ISCHNODON[1] nov.

Type of genotypic species. Ischnodon australis sp. nov.

The diagnostic characters of the genus are those of the genotypic species until other species have been described.

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(1) ἰσχνός, thin; ὀσών=ὀδούς, tooth.

ISCHNODON AUSTRALIS sp. nov.

Holotype. Most of anterior half of right mandible with posterior edge of canine alveolus, P_{1-2} and M_{1-2} in place. P_3 missing from alveolus, M_2 with crack across talonid resulting in loss of posterolingual corner (Fig. 2). U.C. No. 44380.

Generic diagnosis. Horizontal ramus slender; premolar thin transversely (P_1=1·1; P_2=1·6), with long gently declining crest from anteromedian cusp to talonid. Paraconid and hypoconulid reduced on molars; talonid as high as trigonid; height from base of enamel below metaconid–M_1=2·0; M_2=2·1; stylar cusp at anterior base of hypoconid of M_1.

DESCRIPTION.

Mandible. Horizontal ramus evidently nearly straight, perhaps with slight convexity of lower border below molars; depth of mandible below P_1–5·4, below

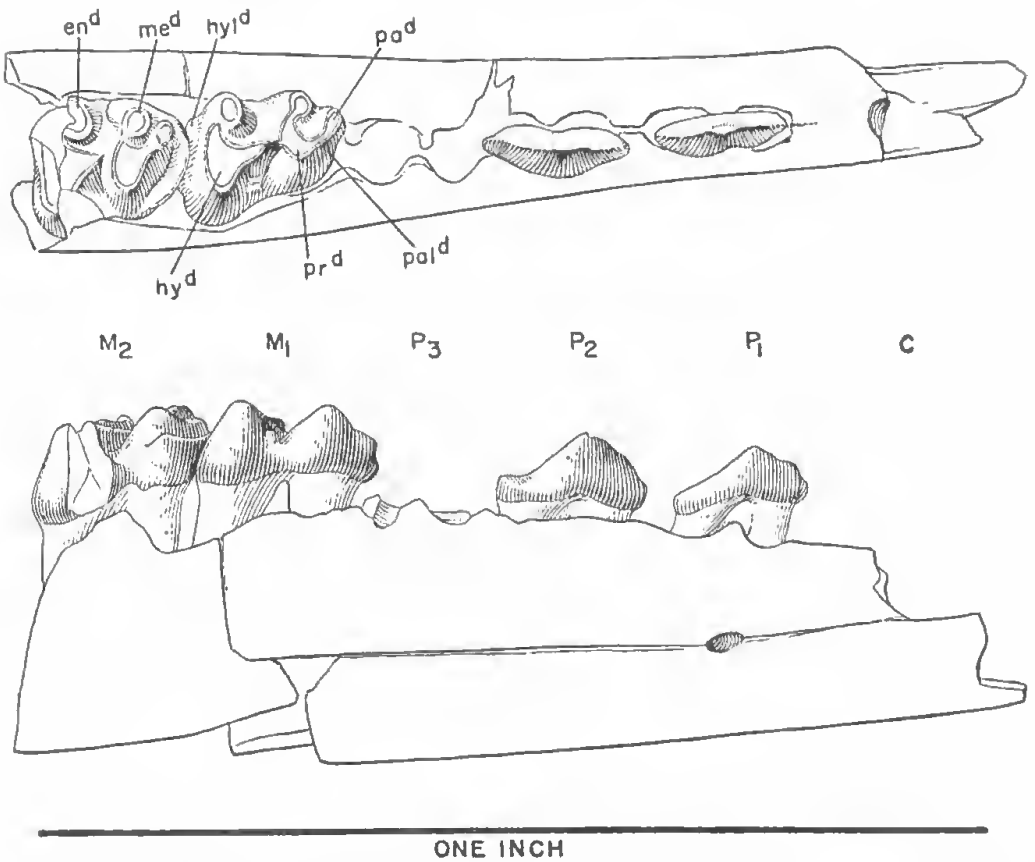

Fig. 2. *Ischnodon australis*, Stirton, n. gen. and n. sp., holotype, No. 44380; Woodard Locality V5367, Palankarinna fauna; Etadunna formation. Most of anterior half of right mandible with posterior edge of canine alveolus, P_{1-2}, alveolus for P_3, and M_1–M_2. Occlusal and labial views. Four times natural size.

anterior edge of M_1–7·0, transverse thickness below M_1–4·9; mental foramen below P_1. Horizontal ramus slender, evidently indicative of long narrow-faced animal.

Teeth. Posterior edge of alveolus of canine preserved; diastem between C and I_1–2·0; P_1 with anteromedian cusp 1·9 high; no tiny cusp at anterior end; long gently declining talonid without cusp; straight; very narrow–1·1; length–3·6. Diastem between P_1 and P_2–1·2. P_2 with anteromedian cusp 2·3 high; no tiny cusp at anterior end; long gently declining talonid with posterior stylar cusp, outline straight lingually and convex labially; wider than P_1–1·6; length–4·1. P_3 missing. Distance between P_2 and M_1–3·5. Molars basically tuberculosectorial but with talonid as high as trigonid; M_1 triangular in outline, lingual edge straight, labial edge tapers from posterolabial corner to anterolingual corner; paralophid and paraconid present; paraconid not in line with metaconid and entoconid, paraconid separated from metaconid by distinct metaflexid; no anterior cingulum; metaconid and entoconid equal in size; hypoconulid vestigial; small stylar cusp at anterior base of protoconid; length 4·1; width across trigonid–2·5, across talonid–3·0; height of metaconid 2·0. M_2 differs from M_1 in less pronounced triangular outline; paraconid reduced; paralophid closely appressed to protolophid; prominent anterior cingulum with stylar cusp at anterior base of protoconid; larger size, length–4·2; width across trigonid–3·2, across talonid–4·5; height of metaconid–2·1.

Comparisons. The exact relationships of the Palankarinna bandicoot cannot be determined from the fragmentary specimen at hand. Nevertheless there are features in the teeth that suggest affinities with living genera. The long gently declining crest from the anteromedian cusp to the talonid on P_1 and P_2, and the reduction of the paraconid and the hypoconulid on the molars are suggestive of affinities with the bilbies. On the other hand, the pattern and height of crown in the molars are much like the features seen in *Thylacis* Illinger (=*Isoödon* Desmarest), but the presence of the paraconid and the hypoconulid, though reduced, may be evidence of a remote relationship to both *Thylacis* and *Perameles*. The characters displayed in this specimen seem to indicate that the Palankarinna animals were nearer to bilbies than to the other genera of the Peramelidae.

Choeropus evidently represents another specialized form related most closely to *Perameles*. The premolars in the Palankarinna specimen are relatively and actually longer and are relatively shorter crowned than in *Choeropus*. Furthermore there are no diastems between the premolars of *Choeropus*. Other differences are reflected in the molars; though considerably larger they are relatively

much lower crowned than in the pig-footed bandicoot. -The paraconids and hypoconulids, also, are more reduced. *Choeropus* is a much smaller animal. The fossil form may be ancestral (but probably is not) to bilbies. If it is in a direct ancestral position the bilbies have experienced considerable evolution in their dentition, especially in becoming higher crowned and in the loss of the paraconid, since the Palankarinna fauna existed in the area east of Lake Eyre.

FAMILY MACROPODIDAE.

Macropodid remains were more numerous at the Palankarinna site than all the other fossils combined. Even in the limited time available for collecting on our first trip to the locality we found a representative of every tooth both permanent and deciduous. Eventually we should have an excellent series for a study of variation in the population.

This new genus and species is recognized as a member of the Macropodinae. Detailed comparisons with other genera in the subfamily have not been completed for this preliminary report.

Genus PRIONOTEMNUS[2] nov.

Type of genotypic species. *Prionotemnus palankarinnicus* sp. nov.[3]

The diagnostic characters of the genus are those of the genotypic species until other species have been described.

PRIONOTEMNUS PALANKARINNICUS sp. nov.

Holotype. Right mandible with P_3–M_4 in place, most of angle, ascending ramus, part of symphysis and incisor missing (Fig. 3), U.C. No. 44381.

Paratypes. Left maxillary with P^3–M^4, U.C. No. 44382 (Fig. 4). Left maxillary with P^2, DP^3, M^1–M^3 in place, M^4 still imbedded in the maxillary, U.C. No. 44384. Left mandible with P_3–M_3 in place, M_4 empty; most of angle, ascending ramus, part of symphysis and incisor missing, U.C. No. 44385. Right mandible with P_3–M_4 in place; most of angle, part of ascending and incisor missing, U.C. No. 44386. Left mandible with P_3–M_4 in place; angle, part of ascending ramus, symphysis and incisor missing, U.C. No. 44387. Part of right mandible with M_{3-4} in place; front half broken off, angle nearly complete, most of ascending ramus missing, U.C. No. 44388. Part of left mandible with P_2 DP_3 M_{1-2} in place, M_3 still embedded in the maxillary, U.C. No. 44839. Right metatarsal IV and associated phalanges, U.C. No. 44383 (Fig. 5). Right

(2) πριων, saw; τέμνω, to cut (in reference to the premolars).
(3) Named for the type fauna at Lake Palankarinna.

P^3, U.C. No. 44390. Composite upper incisors, U.C. No. 44391. Left P^2, U.C. No. 44392. Symphysis of left mandible, U.C. No. 44393. Left lower incisor, U.C. No. 44394. Right P_2, U.C. No. 44395, left DP_3, U.C. No. 44396.

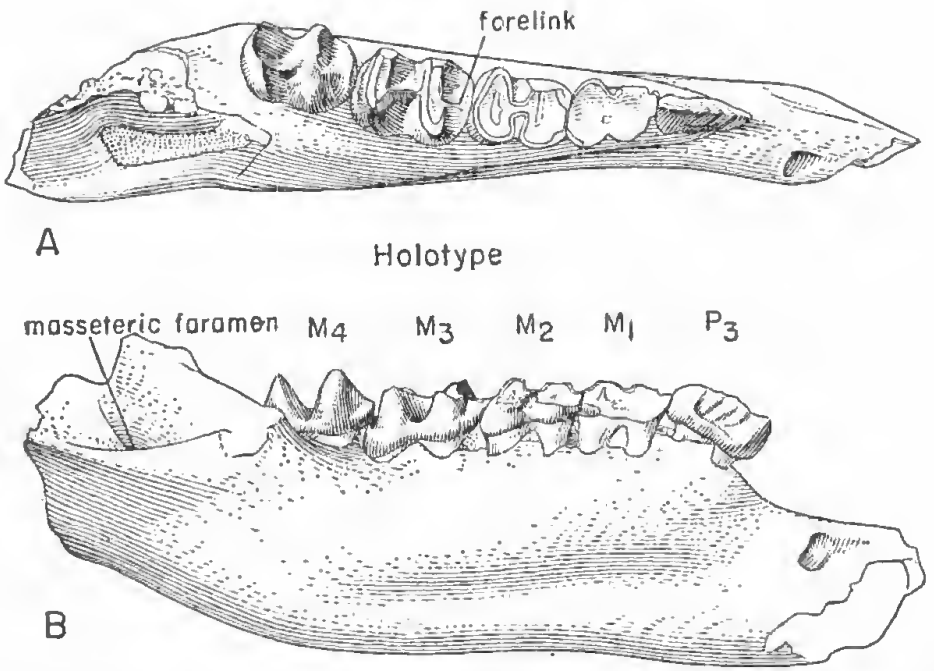

Fig. 3. *Prionotemnus palankarinnicus*, Stirton, n. gen. and n. sp., holotype, No. 44381; Woodard Locality V5367, Palankarinna fauna; Etadunna formation. Right mandible with P_3–M_4; most of angle, ascending ramus, part of symphysis and incisor missing. Occlusal (A) and labial (B) views. Natural size.

Generic Diagnosis. Partial forward rotation of molars. P^2 with no lingual basin; labial surface slightly convex and lingual surface slightly concave. P_3 with four labial and four lingual grooves. P^3 not longer than M^4 nor shorter than M^3; P^3 with narrow lingual shelf and narrow lingual basin; prominent posterointernal cusp; tiny posterointernal fossette. M^1 and M^2 nearly quadrate. $I^{2(4)}$ with enamel extending upward from ventral border nearly halfway on lingual surface; relative proportions of I^2 as in *Wallabia* but larger. P_2 with long, deep and narrow anterior lingual groove and shorter wide posterior lingual groove divided into three parts by two short ridges in apical area of unworn teeth. P_3 usually equal in length to M_2 sometimes as long as M_3; cusps of same height on crest. DP_3 with short crescentic lophid on anterior moiety; crest extends anteriorly from midpoint of anterior crescentic lophid thence labially

(4) Assuming the primitive incisor formula in marsupials was $\frac{1\cdot2\cdot3\cdot4\cdot5}{1\cdot2\cdot3\cdot4\cdot5}$ and that the remaining incisors in the Macropodidae are $\frac{0\cdot2\cdot3\cdot4\cdot0}{0\cdot2\cdot0\cdot0\cdot0}$.

downward and backward along basal part of anterior moiety forming shallow basin on anterolabial corner of tooth. Lower molars longer than wide but relatively wider than in *Wallabia* and in *Protemnodon*.

DESCRIPTION.

Maxillary process opposite M^3, broad 11·5 mm. not rotated transversely, anterior lower border sharp not overturned posteriorly; infraorbital canal 24·0 mm. long, infraorbital foramen above M^1.

Teeth. $I^{2(5)}$ not as elongate anteroposteriorly as I^4, crown of enamel much longer, dimensions of crown almost uniform throughout, length of root variable from 10·0 to 20·0 mm., faint indication of groove slightly back of midpoint on lateral surface; strongly decurved; occlusion on posterior face.

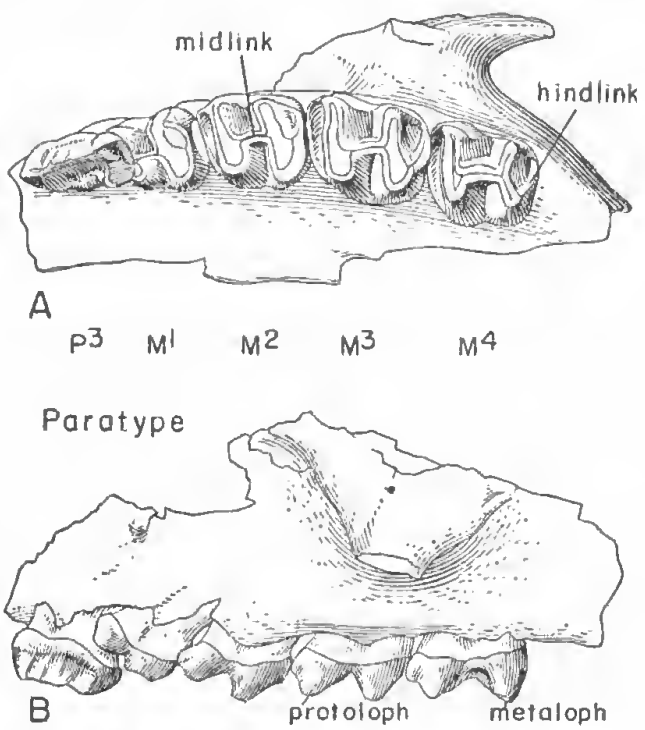

Fig. 4. *Prionotemnus palankarinnicus*, Stirton, n. gen. and n. sp., paratype, No. 44382; Woodard Locality V5367, Palankarinna fauna; Etadunna formation. Left maxillary with P^3–M^4. Occlusal (A) and labial (B) views. Natural size.

I^3 smaller in all dimensions than I^2 or I^4, labial surface convex and smooth, occlusal surface triangular in outline with posterior inflection, crown probably not more than 8·5 mm., root relatively long–9·4 mm.

I^4 crown elongate but narrow, prominent groove and ridge slightly anterior of median labial position, occlusal surface hook-shaped by anterior direction of inflection from lateral groove, crown short–9·1, root approximately 12·0 mm.

(5) This is assuming that I^1 and I^5 have been lost.

Space between alveolus of I^1 and maxillary–premaxillary suture–12·0 mm.

P^2 two wide median labial grooves and two fainter median lingual grooves separated by sharp crest; heavy basal enamel with irregular surface continuous along labial surface, not sharply differentiated into cingulum; slight lingual cingulum basal shelf with irregular surface, no lingual basin; no posterolingual cusp; anterior and posterior ends of crest only slightly elevated above middle part; labial and lingual edges nearly parallel, labial surface slightly convex and lingual surface slightly concave, angulate anteriorly; two roots.

P^3 not longer than M^3 nor shorter than M^2, four labial grooves and four lingual grooves; labial basal cingulum not continuous around posterolabial corner; irregular lingual cingulum forming narrow basal shelf and narrow lingual basin; anterior and posterior ends of crest slightly higher than three intervening cusps; prominent posterolingual cusp; tiny posteromedian fossette; replaces both P^2 and DP^3 with crest pushing up between their roots.

DP^3 molariform but with protoloph narrower than metaloph. All specimens too heavily worn to show detailed pattern.

Upper Molars. Gradation in size from large to small in upper molars M^3, M^4, M^2, M^1; M^3 and M^4 nearly equal and somewhat elongate; M^1 and M^2 nearly quadrate, M^3 and M^4 more elongate; metaloph of M^4 narrower than protoloph; prominent trenchant anterobasal cingulum nearly as wide as protoloph, not sharply deflected palinally from midpoint; no forelink; lophs crescentic in early stages of wear become less so as they wear down; midlink usually formed by spurs developed from protoloph and from metaloph, curved labially and posteriorly from protocone to middle of metaloph, curvature less apparent in later stages of wear, anterior and posterior spurs of midlink usually fused but sometimes not complete particularly in M^3; faint basal lingual cingulum sometimes present on any of the upper molars. Hindlink crescentic on M^1, M^2 and usually on M^3 joins at midpoint with similar but less distinct crest from metacone, extends to base of metacone on M^4 and sometimes on M^3.

Mandible. Symphysial region only slightly upturned in lateroventral outline, not decumbent. Mental foramen usually elongate and ovate, directed anterodorsally, near diastemal crest, distance anterior to P_3 variable (8·4–13·5). Edge of masseteric foramen between opening of posterior dental canal and coronoid fossa observable in adult specimens with mandible in horizontal position at eye level; mandibular ramus, tooth row, and symphysis nearly horizontal.

I_2 lanceolate; slightly curved from tip to end of root in labial outline; labial enamel surface and length of root about equal; enamel extends upward from ventral border nearly halfway on lingual surface; relative proportions as in *Wallabia*; length of diastem between I_2 and C in one adult–36·9.

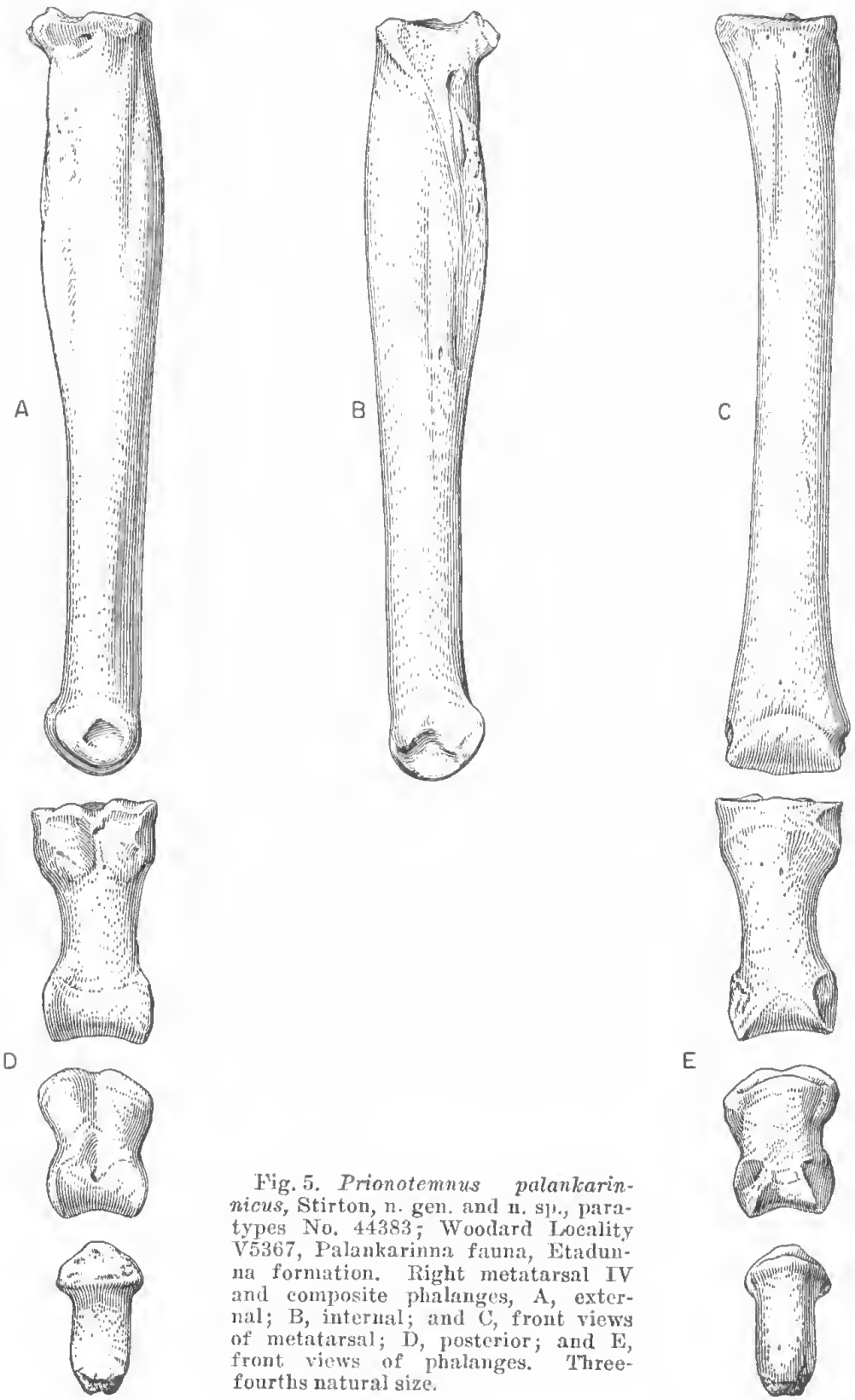

Fig. 5. *Prionotemnus palankarinnicus*, Stirton, n. gen. and n. sp., paratypes No. 44383; Woodard Locality V5367, Palankarinna fauna, Etadunna formation. Right metatarsal IV and composite phalanges, A, external; B, internal; and C, front views of metatarsal; D, posterior; and E, front views of phalanges. Three-fourths natural size.

P_2 long, deep and narrow anterior lingual groove; shorter wide posterior lingual groove, divided into three parts by two short ridges in apical area of unworn teeth; a little over half as long as P_3; apparently two median labial grooves (not clear because of wear in specimens at hand); no indication of basal cingulum; crest moderately serrate, of same height throughout; slightly convex labially, slightly concave lingually; two roots; no posterointernal cusp.

P_3 four labial and four lingual short grooves; labial and lingual cingula not continuous anteriorly or posteriorly; P_3 usually equal in length to M_2 sometimes as long as M_3; serrate crest, cusps of same height; posterior cusp thicker than those in front, slightly deflected lingually; replaces both P_2 and DP_3 with crest directly below these teeth; anterior end sometimes turned downward from rotary pressure of molars behind.

DP_3 submolariform; triangular outline; anterior moiety with short crescentic lophid, posterior moiety bicuspid; crest extends anteriorly from midpoint of anterior crescentic lophid thence labially, downward and backward along basal part of anterior moiety forming shallow lateral basin on anterolabial corner of tooth; another short cingulum extends from anterior midpoint down to anterolingual corner; posterior cingulum; lophids connected by midlink.

Lower Molars. Gradation in size of lower molars M_4, M_3, M_2, M_1; longer than wide; prominent anterior cingulum not equal to full width of tooth; lophids crescentic in early stages of wear become less so as they wear down; forelink curves slightly inward from protoconid then straight forward to anterior cingulum; midlink curves slightly inward from hypoconid then straight forward to middle base of protolophid, no spur extending posterior from protolophid; faint posterior cingulum; no labial or lingual cingula; no hindlink.

Metatarsal IV—anterior surface not conspicuously convex; posterior proximal half of shaft with rather sharp edge; outline of shaft above distal articulating surface ovate.

MEASUREMENTS OF METATARSAL AND PHALANGES.

Length M+ IV	123·2
Width proximal facet	20·3
Width distal articulating surface	19·2
Depth of shaft 90 mm. above distal end	20·2
Width of shaft 90 mm. above distal end	12·3

Remarks. P. palankarinnicus differs from each of the nine species from Queensland described by De Vis (1895) under the generic name *Halamaturus*. The characters examined occur both in the molars and in the premolars, yet characters based on the same structures in our series from the Woodard locality

are constant. Unfortunately neither the geographic location, the stratigraphic position, nor any indication of faunal assemblage information is available for De Vis' specimens. This of course makes a detailed comparison seem rather futile, since characters that are stable in one species are not necessarily stable in another. More than one of his types may come from one fauna. In some features the Palankarinna animals resemble the wallabies and in other characters they look like the species of *Protemnoden* from the Pleistocene. Our form may approximate a common ancestral position to these two genera. The proportions of the limb bones are suggestive of the Macropodinae.

FAMILY DIPROTODONTIDAE.

The relationships of the named genera of the Diprotodontidae are not yet known. The smaller genera referred to the Nototherinae seem to belong to two or more distinct groups, but we do not have enough information on the types and other specimens in museum collections to determine the magnitude of these differences. Lack of information on the stratigraphic position of the fossils and on the associated mammalian faunas has also been a serious handicap in interpreting their affinities. Nevertheless, certain characters seem worthy of comparison and comment at this time. It is hoped that additional discoveries in the near future will clear up the relationships of some of the named genera.

GENUS MENISCOLOPHUS[6] NOV.

Type of genotypic species. Meniscolophus mawsoni[7] sp. nov.

The diagnostic characters of the genus are those of the genotypic species until other species have been described.

MENISCOLOPHUS MAWSONI SP. NOV.

Holotype. Mandibles with complete little worn dentition, ascending ramus and most of angle broken off. Left maxillary[8] fragment with M^2 and M^3 and a right M^3 (Fig. 7, 8, 9). U.C. No. 44397.

Generic diagnosis. Incisors not markedly procumbent nor conspicuously grooved, not caniniform; dorsal outline of incisor slightly concave. Diastemal crest between I_2 and P_3 slightly convex. Posterior end of symphysis opposite anterior moiety of M_1. Length of P_3–17·1, right P_3 4·4 greater than one-half

(6) *μηνίδκος*, crescent; *λοφος*, crest.

(7) Named for Sir Douglas Mawson, Professor emeritus, Department of Geology, University of Adelaide.

(8) Evidently this belongs to the same individual as the mandible since the specimens were found in proximity in the quarry and since both upper and lower teeth are in the same stage of wear.

of length of M_1, left P_3 6·0 greater than one-half length of M_1; no indication of cingulum on anterolabial corner of P_3. Length, width and height (of protolophid from base of enamel below metaconid) of M_4=37·1×26·3×20·9. Lophids of molars slightly crescentic and slightly oblique, midlink not entering into crescentic outline of hypholophid; midlink extends straight forward down into median valley from middle of labial half of hypolophid. No paralophid. Posterior cingulum elevated sharply at midpoint, shallow somewhat widened trench between cingulum and main body of tooth blocked by short low anterior directed ridge at that point. Prominent diagastric process and postdiagastric sulcus on posterior lower border of mandible.

DESCRIPTION.

Mandible. Symphysial region normal, not spatulate nor abruptly upturned; symphysial sulcus markedly U-shaped laterally, slightly convex anteroposteriorly on lingual surface along symphysial suture, narrow (1·5 wide) deep groove along symphysial line fades out 19·0 back of incisor alveolar border; ventral surface also with grooved sutural line, 39·5 this groove expands into elongate (41·7) relatively narrow (10·0) slightly depressed rugose area; subalveolaris fossa distinct; spina mentalis broken off; no torsus transversus; diastemal crest between incisor and P_3 pitted and grooved; mental foramen ovate 8·5 vertically and 5·8 anteroposteriorly, 27·5 below and 8·3 anterior to P_3. Lower border of ramus slightly convex between symphysial notch and diagastric process; diagastric process prominent, pointed; long (80·0) pronounced postdiagastric sulcus between diagastric process and base of angle; angular fossa deep (approx. 16·0) and continues forward as shallower depression 70·0 beyond postdiagastric process. Posterior angular surface nearly flat, 75+ wide below condyle (broken cannot be measured accurately); only base of ascending ramus preserved, anterior border opposite anterior moiety of M_4; postalveolar shelf back of M_4 triangular, 25·0 long, with postalveolar ridge extending more or less uninterrupted to postalveolar process at edge of postdental canal. Postdental canal 9·0 in diameter, 51·0 back of and on level of upper half of M_4, canal runs under labial border of tooth row; basal part of coronoid fossa 77·0 wide and 15·0 deep.

Lower teeth. Diastem between incisors 6·0; incisors curved gently upward and slightly outward, extends 37·0 out of alveolus; anteroventral and labial surface of incisor coated with enamel, enamel extends 12·0 into alveolus, lower surface not grooved, upper lateral surface slightly grooved near contact with exposed dentine surface, dorsal surface of dentine also slightly grooved near lateral border; dentine exposed on inner and posterior surfaces, enamel occurred

on these surfaces; thick root, reduces in size at lower end, open, not compressed laterally, terminates about 20·0 back of and below mental foramen and below P_3; dental canal passes down and over labial side of open root.

Cheekteeth decrease in size from M_4 to P_3, but M_3 only slightly smaller than M_4; some cement in depressions of teeth.

P_3 moderately worn, evidently with single cusp, exposed dentine roughly triangular, expanded cingulum extending from posterolingual corner to point between roots on labial side, shallow somewhat widened trench between cingulum and main body of tooth, no indication of anterior cingulum; lingual edge straight; no indication of vertical lateral grooves dividing tooth into anterior and posterior moieties; labial enamel 2·0 thick, lingual enamel 0·5 thick; both roots curved posteriorly.

Pattern of molars alike except shelf-like cingulum structure across opening of median valley more prominent on lingual side of M_3 and M_4 and more pronounced on labial side of M_1 and M_2. Lophids slightly crescentic and slightly oblique; protolophid not higher than hypolophid. Anterior and posterior moieties about equal in width except on M_1 where anterior moiety is a bit narrower; posterior moieties on M_2, M_3 and M_4 as wide or slightly wider than anterior moieties; posterior moieties longer anteroposteriorly than anterior moieties on all of the molars. Median valleys sharply V-shaped. Posterior cingulum elevated sharply but not discontinuous at midpoint, shallow somewhat widened trench between posterior cingulum and main body of tooth blocked by low crest at that point. Midlink extends straight forward down into median valley from labial side of hypholophid. Cingula discontinuous opposite labial and lingual surfaces of protolophids and hypolophids, tend to ascend but fades out on these surfaces.

Upper teeth. Lophs crescentic and slightly oblique; anterior moiety wider than posterior moiety; median valleys sharply V-shaped; only slight elevation in area of midlink; wide anterior cingulum, without labial cusp; short cingula across lingual and labial openings of median valleys; wide posterior basal cingula. Posterior edge of jugal arch opposite anterior edge of M^3.

MEASUREMENTS.

Length from tip of incisor to posterior angular surface	350·0
Length from tip of incisor to entry of dental canal	290·7
Depth of ramus below anterior alveolus of M_1	70·0
Depth of ramus below anterior alveolus of M_3	61·0
Thickness of ramus below M_1	33·5
Length of symphysis	113·0
Depth of symphysis at midline opposite mental foramen	47·8
Diastem between incisor and P_3	62·9

Length of teeth measured at middle and on left tooth row.

P_3–M_4=150·3; P_3–M_3=113·4; P_3–M_2=77·6;
P_3–M_1=46·4; M_1–M_4=133·4; M_1–M_3=96·7;
M_1–M_2=61·0; M_2–M_4=103·9; M_2–M_3=67·9;
M_3–M_4=72·8.

Median length × width of anterior moiety × width of posterior moiety, except P_3 which is measured across the middle.

P_3=17·2×13·0; M_1=29·0×20·0; M_2=32·4×22·8;
M_3=36·4×26·0; M_4=37·1×26·3.

Height of anterior lophid from base of enamel below metaconid of M_4 20·9
Length M^2–M^3 .. .. 69·1
Median length × width of anterior moiety × width of posterior moiety.

M^2=31·6×28·0×26·4 M^3=37·0×31·1×28·6

Comparison. The generic name *Nototherium* is second only to *Diprotodon* in its frequency in the literature. Ironically though, in all probability the specific characters in the type of the genotypic species *N. mitchelli* Owen (1845, p. 223, pls. 3–4) from the "alluvial or newer tertiary deposits in the bed of the Condamine River, west of Moreton Bay," can never be recognized. If this proves to be true the name *mitchelli* must be set aside as a *nomen dubium*[9] or *nomen vanum*[9]. It seems unwise to treat the generic name in a like manner as long as there is a possibility of recognizing generic affinities of the other species with the type of the genotypic species.[10]

Owen's type of *Nototherium* is the posterior part of a left mandible with M_3 and M_4 in place but nearly all of the enamel on the teeth has been shattered and lost. The posterior lower border of the horizontal ramus is complete but the ascending ramus is broken off. Unfortunately the teeth are so badly broken an accurate determination of affinities from them will be extremely difficult. In comparing the type with other specimens in the British Museum of Natural History it was found to be more like specimen No. 43523 (Owen, 1877, pp. 289-290, pl. XLV) than any other specimen with which it was compared. Some enamel still preserved in the median valley of M_3 in the type is indicative of a V-shaped valley as in the specimen mentioned above. This feature is also found in the type of *Euryzygoma dunense* (De Vis), 1887. *Euryzygoma* agrees with the British Museum specimen No. 43523 in that the midlink on the molars is

(9) Evidently these terms are synonymous.

(10) Thus the opinion expressed by Savage (1951, p. 260, footnote 7) is followed in his treatment of the genus *Camelops*. It is appreciated though that the case of *Nototherium* differs from that of *Camelops* in that I am still not certain that the genus can be recognized in Owen's type.

continuous as a labial curvature of the hypolophid. Furthermore, *Euryzygoma* resembles Owen's type and the British Museum specimen No. 43523 in the absence of a pronounced diagastric process and postdiagastric sulcus. *N. mitchelli* differs further from *Meniscolophus* in its postalveolar process being 40·0 below the opening of the postdental canal. In both *Euryzygoma* and the referred *Nototherium*, the lophids are more obliquely crescentic than in *Meniscolophus*. In addition *Meniscolophus* differs from both of these genera in the anteroposterior direction of the midlink, and in the midpoint elevation of the posterior cingulum. V-shaped median valleys are found in all of these genera. *Euryzygoma* differs from *Meniscolophus* in its larger size, more procumbent and more pronounced lateral grooved incisors. Other features of distinction in *Euryzygoma* are seen in the posterior end of the symphysis being opposite the anterior end of M_2, in the length of P_3 which is one-half the length of M_1, and in the protolophid being 5·0 higher than on M_4 in *Meniscolophus*.

Both *Euowenia robusta* De Vis, 1891, and *Euowenia grata* (De Vis), 1887, show marked resemblances to *Meniscolophus* in the construction of the molars, in the presence of a diagastric process and a diagastric sulcus. They differ in the shape of the symphysis and in the outline and direction of the incisors. There also are minor differences in the molar patterns. The symphysis in *robusta* is long (197·2), narrow (51·8 between mental foramina), slightly upturned, and with the symphysial notch below M_2. On the other hand the symphysis is much shorter in *grata* (116·8), wider (70·1 between mental foramina), abruptly upturned and with the symphysial notch below M_1.

I designate *Euowenia robusta* De Vis, 1891, as the genotypic species since De Vis did not refer to either species as the type of his new genus. The type specimens of these two species will be described in detail at a later date by Jack T. Woods of the Queensland Museum.

Though the generic affinities of "*Nototherium*" *victoriae*, Owen, 1873, are not clear and it differs from *Meniscolophus* in several features it seems nearer to the Palankarinna genus than to the other genera and species. It differs from *Meniscolophus* as follows: posterior end of symphysis opposite middle of M_2. Length width and height (of protolophid from base of enamel below metaconids) of M_4=45·3×33·5×24·6 approx. Lophids transverse. Midlink not as pronounced but in same position. Diagastric prominence as long as postdiagastric sulcus. Postdental canal about on same level in relation to tooth row as in *Meniscolophus*, but separated from postalveolar shelf and postalveolar ridge by deep groove. Median valley not as sharply V-shaped. Shelf-like cingula structures across openings of median valleys of molars not prominent. Trench between posterior cingulum and main body of tooth not blocked by crest. Length M_2–M_4=122·0.

"Nototherium" tasmanicum, Scott, 1911, seems to be close to *"N." victoriae* except in the position of the foramen of the postdental canal, which is high on the ascending ramus as in the type of *"N" mitchelli*.

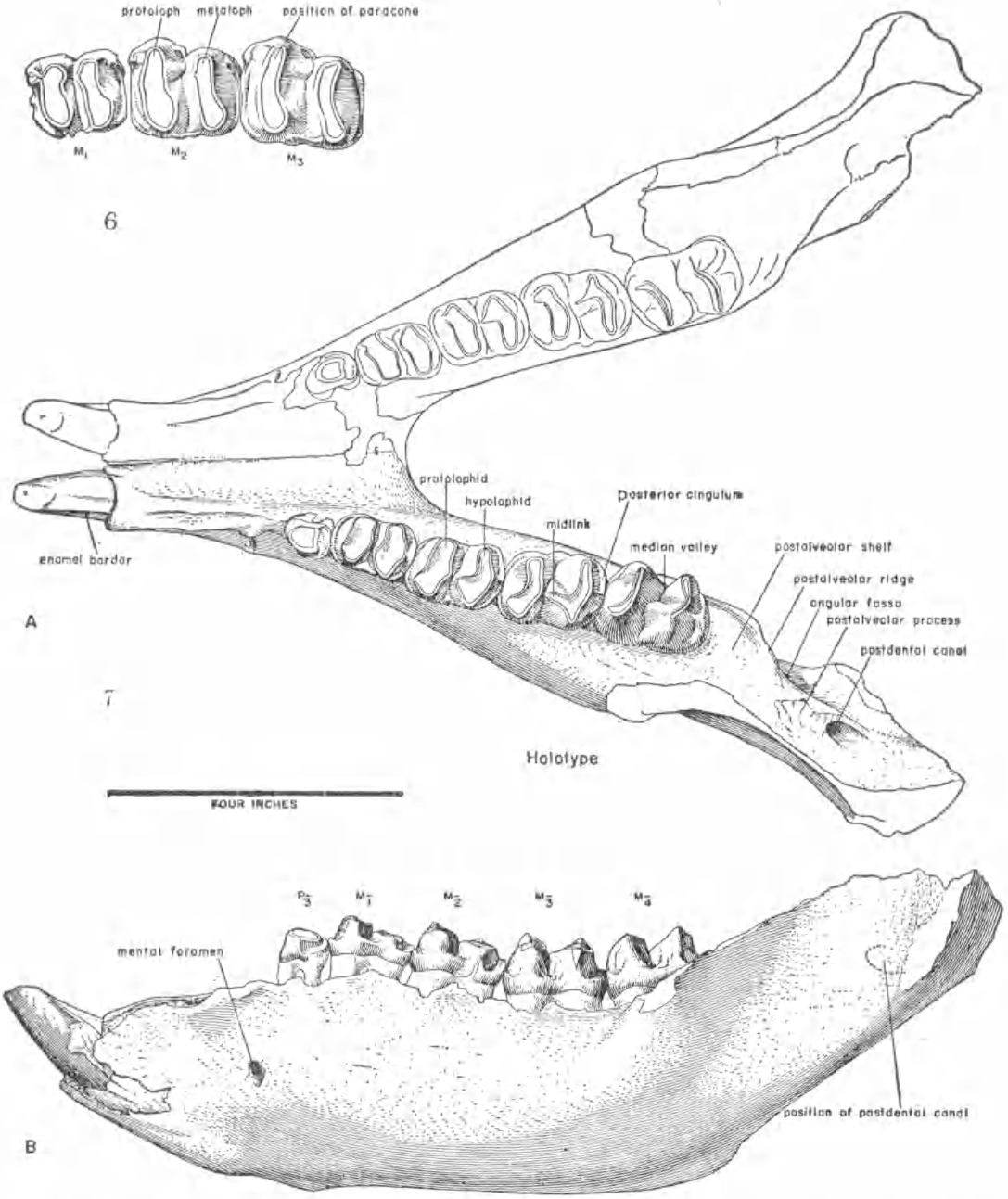

Fig. 6. Diprotodont, No. 44398; Woodard Locality V5367; Palankarinna fauna; Etadunna formation. Part of left maxillary with M^1–M^3. Occlusal view. One-third natural size.

Fig. 7. *Meniscolophus mawsoni*, Stirton, n. gen. and n. sp., holotype No. 44397. Woodard Locality V5367; Palankarinna fauna; Etadunna formation. Mandibles with little worn incisors and P_3–M_4, ascending ramus and most of angle broken off. Occlusal (A) and labial (B) views. One-third natural size.

"Nototherium" watutense, Anderson, 1937, is represented by a very poor type specimen since only a fragment of M_4 remains in part of the mandible. Nevertheless the presence of a diagastric process and a postdiagastric sulcus give evidence of a mandibular outline, at least in that area, much like that in *Meniscolophus*. Though the tooth of a possible topotype from Surprise Creek, near Wau, New Guinea (Australian Museum No. F41443), is much lower crowned and smaller than *Meniscolophus*, has median valleys not so narrow, has a much more complete anterior posterior and labial cingulum, but has slightly oblique lophids and midlinks, though not as prominent, in the same position as in *Meniscolophus*, *"N." watutense* is probably referable to the genus *Meniscolophus*.

It is not clear at this time to which of the smaller nototheres *Diprotodon* is most closely related. It is much larger, has a longer cranium and mandible, and the cheekteeth, though brachyodont, are both relatively and actually higher crowned. It shows a marked similarity to *Meniscolophus* in the diagastric process, in the postdiagastric sulcus, the postalveolar ridge leading from the postalveolar shelf to the postdental canal, but in other features it is not close. The large incisors have open roots; if root closure took place it must have been in the oldest individuals. On the other hand the area covered with enamel on the incisors is somewhat like that in *Meniscolophus*. The pattern of the molars in their transverse crescentic lophids, in the absence of midlinks, in the presence of cement both in the median valleys and on other surfaces of the molars, is quite different from *Meniscolophus*.

Some of the characters mentioned here may prove useful in an interpretation of phylogenetic relationships when we have more information on the Tertiary fossil record of the Diprotodontidae.

DIPROTODONT.

Four notothere specimens from Palankarinna are clearly not referable to *Meniscolophus*. These are the back part of a left mandible with a well-worn M_4 in place, U.C. No. 44401, a fragment of a left mandible with a moderately-worn M_4 (Fig. 10) U.C. No. 44390, a left maxillary fragment with M^1–M^3 moderately worn (Fig. 7), and a left M^1 of a smaller individual U.C. No. 44400 (Fig. 11). The following characters indicate affinities with part of a maxillary from the marine Miocene near Beaumaris, Victoria, but it is thought that materials from Palankarinna are not referable to the species from Victoria, though it may belong to the same genus.

Upper molars with protoloph transverse and with metaloph slightly oblique; anterior moiety wider than posterior moiety except on M^1; median valley wide; slight elevation of midlink-like structure in median valley back of

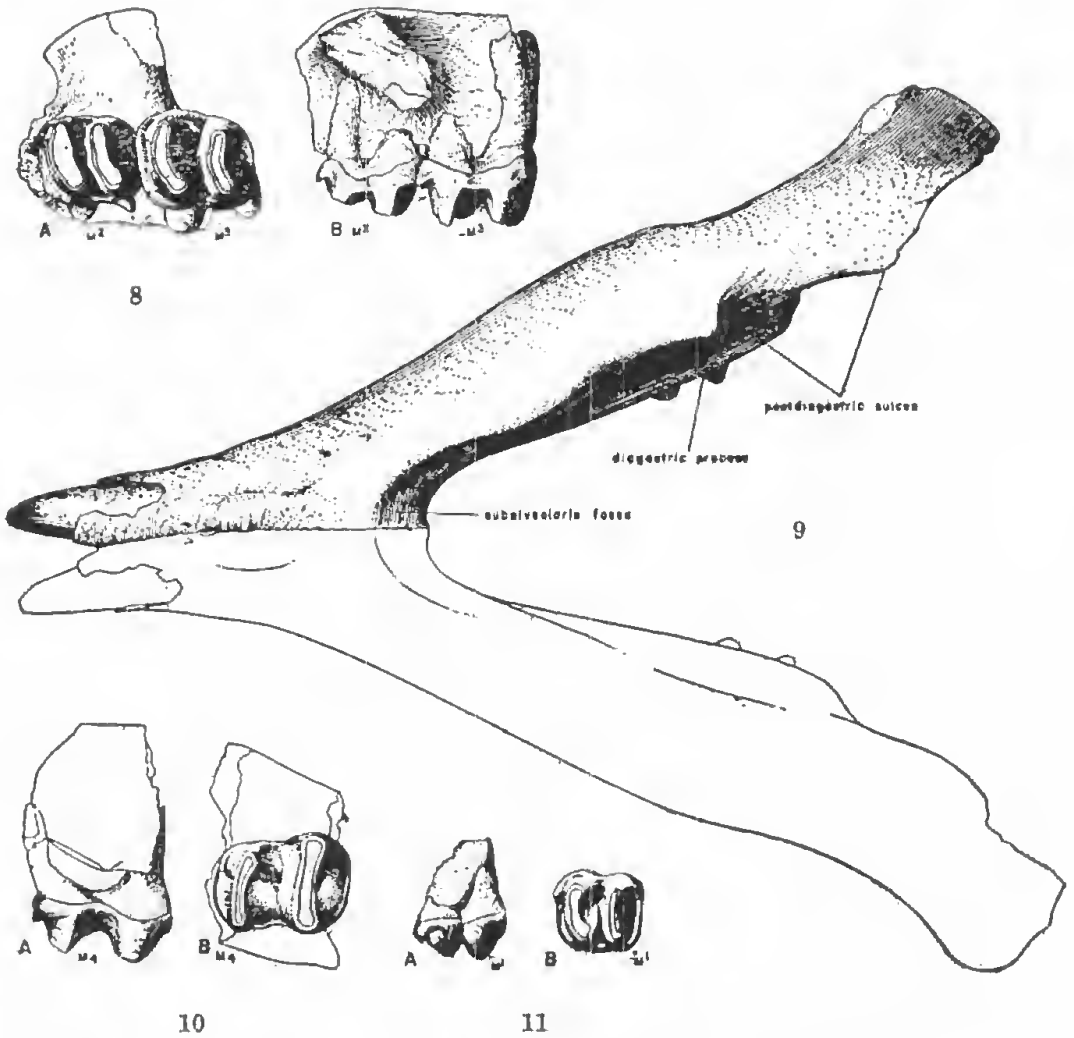

Fig. 8. *Meniscolophus mawsoni*, Stirton, n. gen. and n. sp., holotype No. 44397, Woodard Locality V5367, Palankarinna fauna; Etadunna formation. Part of left maxillary with M^2 and M^3. Occlusal (A) and labial (B) views. One-third natural size.

Fig. 9. *Meniscolophus mawsoni*, Stirton, n. gen. and n. sp., holotype No. 44397. Woodard Locality V5367; Palankarinna fauna; Etadunna formation. Mandible. Ventral view. One-third natural size.

Fig. 10. Diprotodont, No. 44397. Woodard Locality V5367; Palankarinna fauna; Etadunna formation. Right M_4. Labial (A) and occlusal (B) views. One-third natural size.

Fig. 11. Diprotodont, No. 44400. Woodard Locality V5367; Palankarinna fauna; Etadunna formation. Left M^1. Labial (A) and occlusal (B) views. One-third natural size.

paracone; wide anterior cingulum with labial cusp; wide posterior cingulum with labial cusp; short cingulum across lingual opening of median valley; stylar cusp at posterior labial base of paracone, does not cross labial opening of middle valley. Posterior edge of jugal arch opposite middle of M^3.

M_4 with transverse crescentic lophids; anterior cingulum less prominent than in upper molars; anterior moiety wider than posterior moiety; median

valley wide; slight elevation of enamel in area of midlink; no indication of cingula across opening of median valley; posterior cingulum slightly elevated at midpoint; shallow trench between posterior cingulum and main body of tooth not blocked by low crest at midpoint.

Lower mandibular outline like that in *N. mitchelli*.

MEASUREMENTS.

No. 44398.

Length M^1–M^3	109·5
Length M^1–M^2	67·9
Length M^2–M^3	80·2

No. 44398.

Median length × width of anterior moiety × width posterior moiety

M^1=31·9×27·9×28·0 M^2=37·8×33·7×31·1 M^3=43·4×36·1×32·4

No. 44400.

M^1=27·4×25·8×25·6

No. 44401.

Depth of ramus below anterior alveolus of M_1=79·0

No. 44397.

Median length × width of anterior moiety × width of posterior moiety

M_4=43·4×32·6×29·0

Comparison. The Palankarinna form is larger than the largest specimen from New Guinea (7·0 in the length of M_4) and almost twice as large as the Beaumaris specimen, from Victoria (15·6 difference in the length of M^3). Irrespective of the difference in size characters in the Palankarinna maxillary seem to be foreshadowed in the Beaumaris form except in the following features.

Posterior moiety relatively narrower transversely; anterior cingulum with labial cusp less developed but distinct; no stylar cusp at posterior labial base of paracone; posterior edge of jugal arch apparently opposite anterior edge of M^3.

If, as the evidence seems to indicate, the specimen from Beaumaris is in or near the line of ancestry to the Palankarinna diprotodont and the unit of the Sandringbam sands from which it came is late Miocene in age (Singleton, 1941; Gill, 1950; Glaessner, 1951) our fauna probably belongs in the early Pliocene. On the other hand, if the Beaumaris fossil is early Pliocene (Crespin, oral communication) then our fauna could be middle Pliocene.

Unfortunately the specimens at hand offer meagre evidence for a generic diagnosis, though some of the features observed may be of generic magnitude. Nevertheless it seems expedient to await the results of another field season in anticipation of a more revealing type specimen.

TEDFORD LOCALITY[11]

FAMILY PHASCOLARCTIDAE.

Tedford discovered a fragment of a right maxillary of a koala-like animal among fragments of other vertebrates approximately 25 feet below the Woodard locality. The specimen contains the posterior border of the alveolus of P^3, the roots of M^1, M^2 with much of the enamel surface and the inner edge broken away, part of the alveolus of M^3, and the base of the jugal arch.

Though the specimen shows a marked resemblance to *Phascolarctos* it differs in several features. Anteorbital fossa shallow; width of base of jugal arch opposite M^2=6·7; enamel surface of molar conspicuously crenellated; protocone and hypocone more crescentic; M^2 as wide as long; length 6·3, width 6·3; occlusal outline of M^2 evidently more rounded.

This fossil is more closely related to the koala than to *Pseudocheirus*, *Schoinobates* or *Hemibelideus*. It differs from "*Pseudochirus* (?)" *notabilis*[12] De Vis, 1889, from Freestone Creek, Queensland, in the crenellated enamel surface of M^2, in that tooth being as wide as long, and in its more rounded outline. Perhaps additional discoveries at Lake Palankarinna will clear up the relationships of this animal.

SUMMARY.

Late Tertiary vertebrate remains are reported from the west side of Lake Palankarinna east of Lake Eyre, South Australia. The assemblage is named Palankarinna fauna. In accompanying notes the stratigraphic unit in which it occurs has been described as the Etadunna formation by G. D. Woodard. Locally the mammalian fossils are abundant in a channel deposit called the Woodard locality. The age seems to be early or middle Pliocene.

Preliminary descriptions of the mammals include: PERAMELIDAE—*Ischnodon australis* n. gen. and n. sp.; PHASCOLARCTIDAE—phascolarctid, specimen not adequate for diagnosis (found on the same level as the Woodard locality and in the Etadunna formation); MACROPODIDAE—*Prionotemnus palankarinnicus* n. gen. and n. sp.; DIPROTODONTIDAE—*Meniscolophus mawsoni* n. gen. and n. sp.; diprotodont specimens not adequate for diagnosis. Teleost, dipnoian, chelonian, crocodilian fragments and crayfish gastroliths also were found.

Ischnodon seems more closely related to the bilbies than to *Perameles* and *Thylacis* but in some features it displays relationships with these genera. The

(11) See stratigraphic position under section on stratigraphy.

(12) This type is not referable to the genus *Pseudocheirus*, but is much closer to the koala.

phascolarctid is clearly nearer to the koala than to *Pseudocheirus, Schoinobates Hemibelideus* or *Petropseudes*. It also differs from "*Pseudocheirus* (?)" *notabilis*, De Vis, 1889, in certain details. *Prionotemnus* has some characters in common with the wallabies and others that resemble *Protemnodon*. It may represent a proximity to a common ancestor of both genera. *Meniscolophus* and the unidentified nototherе share characters with most of the proposed genera and species of the Nototherinae.

LITERATURE CITED

Anderson, C. (1937). Paleontological notes. Fossil marsupials from New Guinea. Rec. Aust. Mus., vol. 20, No. 2, pp. 73-87, pl. 8.

De Vis, C. W. (1887). On a supposed new species of *Nototherium*; Proc. Linn. Soc. N.S.W., vol. 2, pp. 1065-1070, pl. 38.

De Vis, C. W. (1889). On the Phalangistidae of the post-Tertiary period in Queensland. Proc. Roy. Soc. Queensland, vol. 6, pp. 105-114, pls. 4-5.

De Vis, C. W. (1895). A review of the fossil jaws of the Macropodidae in the Queensland Museum. Proc. Linn. Soc., N.S.W., vol. 10, pp. 75-133, pls. 14-18.

Gill, E. D. (1950). Nomenclature of certain Tertiary sediments near Melbourne, Victoria. Proc. Roy. Soc., Victoria, vol. 62, pp. 165-170, Figs. 1-2, pl. 10.

Glaessner, M. F. (1951). Three foraminiferal zones in the Tertiary of Australia. Geol. Mag., vol. 88, pp. 273-283.

Owen, R. (1845). On the extinct mammals of Australia. Rept. Brit. Assoc. Adv. Sci., for 1844, vol. 14, pp. 223-240.

Owen, R. (1873). IV. On the fossil mammals of Australia—Part V. Genus *Nototherium*, Owen. Phil. Trans. Roy. Soc., London, vol. 162, pp. 41-82, Figs. 1-2, pls. 2-11.

Savage, D. E. (1951). Late Cenozoic vertebrates of the San Francisco Bay region. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 28, pp. 215-314, Figs. 1-51.

Scott, H. H. (1911). *Nototherium tasmanicum*. Tasmanian Naturalist, vol. 2, No. 4, pp. 64-68, Figs. 1-5.

Singleton, F. A. (1941). The Tertiary geology of Australia. Proc. Roy. Soc., Victoria, vol. 53, pp. 1-125, Figs. 1-15, pls. 1-3.

Stirton, R. A. and Woodard, G. D. (1954). Continental stratigraphy and late Tertiary marsupials in South Australia (abstract). Proc. Geol. Soc., Amer. (in press). Read March 12, 1954, Cordilleran Sec., Seattle, Wash.